TERMS OF REFERENCE FOR R&D PROJECT

Food and Agriculture Department

Slaughterhouse and Meat Industry Sectional Committee, FAD 18

1 Title of the Project

Development of smart sensor probe-based method for rapid detection of freshness of dressed chicken.

2 Background

2.1 Food safety is the key issue in food trade to enhance health security from both national and international perspectives. The key global food safety concerns include spread of microbiological hazards due to rapidly changing technologies in food production, processing and marketing. Since meat is a highly perishable item it rapidly undergoes microbial spoilage/decay. Further, due to changes of life style and busy working schedules, consumers prefer to purchase packaged chicken meat (chilled/frozen) in place of live slaughtering of chicken while purchasing. Thus, it is felt that checking of meat for freshness at the point-of-sale/purchase is very much desired for ensuring safety and authenticity. However, there is no rapid test available for detection of freshness in meat.

2.2 Conventional methods of analysis use sophisticated instruments such as gas chromatography, electromagnetic interrogation, spectroscopy, PCR techniques and other molecular techniques to detect freshness in meat in the supply chain are time consuming, tedious, non-specific, and expensive, need sample pretreatment and require the use of highly trained personnel. The current tendency to carry out field monitoring has driven the development of smart sensors-based technique as this new analytical tool is able to provide fast, reliable, and sensitive measurements with low cost. Use of multi-dye smart sensor coupled with mobile interphase technique will overcome the difficulties encountered in conventional methods. This technique will help to generate rapid and accurate information with greater degree of user flexibility for the food producing, processing and serving industries, food safety risk assessors, policy makers and regulators, public health authorities, and consumers by examining production practices and/or interventions strategies to control or reduce postharvest losses through spoilage or pathogenic microflora on resulting carcasses or meat and their products.

2.3 In order to address the above concern, it has been decided to conduct a detailed study to develop a rapid method pertaining to development of smart sensor probes for rapid detection of freshness of dressed chicken. Based on the detailed research study under the project, a new method of analysis will be developed for rapid detection of freshness of chicken during different storage conditions. Considering that there is little information available in the country on this subject, this research will be very important in standardizing and validating a simple, specific and reliable rapid smart sensor probe-based test method for rapid differentiation of fresh and spoiled meat in the supply chain, testing and evaluating the microbial status of chicken meat during storage at refrigeration temperature.

More information on rationale and relevance of the project is provided at Annex A.

3 Objective of the Project

To develop/optimize smart sensor probe-based method for rapid detection of freshness of dressed chicken and validation of the test method.

4 Scope

4.1 Study of existing literatures related to published research conducted, international/ regional guidelines & standards related to smart sensor probe-based rapid detection method of freshness of dressed chicken and any other relevant national/ international documents.

4.2 Visit to laboratories/research institutes working on development of analytical methodology related to smart sensor probe-based method for rapid detection of freshness of dressed chicken, if any.

4.3 Development of a simple, low-cost smart sensor-based probe for rapid differentiation of fresh and spoiled meat.

4.4 Collection of field samples of meat and screening for required validation study.

4.5 Intra and inter-laboratory validation of the test methodology

4.6 Comparative study of the microbiological status of chicken meat at the point of purchase and sale.

4.7 Comparative analysis of existing test methods for freshness detection of dressed chicken with the new proposed method.

4.8 Preparation of the technical report and provide recommendations in the form of requirements

5 Research Methodology

5.1 Conduct a thorough literature review should be done for national and international guidelines, regulatory stipulations, national/international/regional standards, any industry specific innovative testing protocols for detection of freshness of dressed chicken.

5.2 Conduct primary survey through structured interview/ structured questionnaires with laboratories/research institutes working on development of rapid method for detection of freshness of chicken, if any; to understand the existing testing protocols or ongoing research related to the subject.

5.3 The test method for differentiation of fresh and spoiled meat will be developed with the correlation of microbial quality of fresh chicken meat (chilled) during storage.

5.4 Conduct Intra and Inter-laboratory validation of the entire smart sensor probe-based test method and associated protocols.

i. The validation study shall be performed for specificity, linearity, precision (repeatability & reproducibility) limit of detection, limit of quantitation, accuracy, robustness and sensitivity as per relevant parts of ISO 5725 'Accuracy (trueness and precision) of measurement methods and results'.

ii. The inter-institute validation will be carried out with involvement of important national research institutes in the field of meat/poultry research. For intra-institute validation, it should be carried out in different labs in the same institute.

5.5 Conduct screening of field meat samples (n=150 to 200) and analysis of freshness using validated test method.

5.6 Prepare report consisting of research findings and data collected as per the deliverables of this project.

6 Deliverables

Detailed project report of the work done, in hard copy and digital formats, as per the scope specified under 4, with the following as appendices:

a) Optimized protocols for detection of freshness of dressed chicken;
b) Validation report including data generated, test results, repeatability, its limit of detection and quantification;
c) Available novel methodology/procedures for detection of freshness of dressed chicken and the comparative analysis with the proposed method, if any; and
d) Response/information collected during primary survey.

7 Timeline and Method of Progress Review

7.1 Timeline for the project is 6 months from the date of award of the project.

7.2 Stages of review

Stage	Timeline
Stage I : Review of the literatures and existing stipulations, sampling plan and validation plan	First month

Stage II : Optimization/development and validation of test method(s) and testing of validated method(s) on the field samples. Submission of interim report to Sectional Committee at the end of third month for review.	Second to Fifth month
Stage III : Draft report submission – Sectional Committee will evaluate the draft report and provide feedback/recommend changes, if required.	End of Fifth month

At the end of 6th month, project allottee to submit final project report incorporating recommendations/feedback of Committee.

***Note**: The timelines given above are indicative and calculation of time will start from the date of award of sanction letter for the project to the Project leader.*

8 Support from BIS

8.1 Access to Indian and International Standards

8.2 Letters from BIS to concerned stakeholders for support in research project.

9 Nodal Officer

Shri Debasish Mahalik, Scientist-B/ Assistant Director, FAD, BIS may be contacted at fad18@bis.gov.in for any queries on the research project

Annex A

A.1 Rationale /Need of Project

Rationale of the project is to address a critical issue related to food safety. Safety of meat product is the major concern as expressed by many meat eating consumers around the globe. Now-a-days consumers want customized meat products, they want meats that are fresh, safe, natural and contained fewer chemical additives. Since meat is highly perishable items they undergo decay or spoilage changes very rapidly and their detection using simple technique is very much desired to safeguard the consumers. In the recent year, it has been observed that meat production and consumptions has increased tremendously so there may be more chances of accidental contamination of fresh produce. Further, due to changes of life style and busy working schedule, consumers are purchasing packaged chicken meat (chilled/frozen) instead of slaughtering chicken in front of them while purchasing. Thus, it is felt that quality checking of meat for freshness at the point-of-sale/purchase is very much desired for safety and authenticity. However, there is no rapid test available for freshness detection of meat. So, safety status and quality checking of meat producing under different farming system across the country at different agroclimatic zones are important. Further, for proper marketing of dressed birds they deemed required branding and grading. Improper branding, absence of proper labelling for shelf-life/best before use date and improper/inadequate safety information may leads to consumer abuse about the quality and safety of the packaged products. In summary, to supply good quality of meat to the consumers and also to protect consumer health there is urgent need of setting up new BIS standard for differentiation of fresh and spoiled meat considering present climate changing scenario, farming practices, processing conditions and demand by the consumers. It is expected, it will be helpful to the producer, processor and consumers to identify the freshness of meat.

A.2 Relevance of the study

Freshness of meat products is important to safeguard to consumers from possible health risk through consumption of spoiled meat or unauthorized meat. In the past, freshness of meat and products usually determined using conventional sensory evaluation techniques like tactile, visual, and olfactory assessments. Using the visual method, one can observe how the meat products' colors change (Altmann et al., 2022). Using the tactile method, one can evaluate the meat products' viscosity, muscle texture, and hardness/springiness. The olfactory method determines offensive smells, deterioration, and spoiling that could be signs of a low-quality meat product. The approaches outlined above, however, are mostly dependent on the subjective experiences and behaviours of a single person, who may not always be reliable or accurate in the evaluation. On the other hand, scientific sensory evaluation uses experts in the field as assessors to produce assessments that are more precise and impartial. To evaluate the quality of fresh meat products, this may involve conducting a microbiological experiment, measuring physical and chemical indices, or utilizing sensory evaluation in conjunction with physical and chemical indices (Zhang et al., 2023).

Further, conventional methods of analysis use sophisticated instruments such as gas chromatography, electromagnetic interrogation, spectroscopy, PCR techniques and other molecular techniques to detect food quality in the supply chain are time consuming, tedious, non-specific, and expensive, need sample pretreatment and require the use of highly trained personnel.

The current tendency to carry out field monitoring has driven the development of smart sensors based technique as new analytical tools able to provide fast, reliable, and sensitive measurements with low cost. Use of PCR techniques for the detection of spoilage bacterial and other pathogens in meat though sensitive and selective enough, but time-consuming, even days to weeks are needed to get a result. Quite often, rapid and reliable analysis is necessary for quick decision-making. Use of multi-dyes smart sensor coupled with mobile interphase technique will overcome the difficulties encountered in conventional methods. This technique will help to generate rapid and accurate information with greater degree of user flexibility for the food producing, processing and serving industries, food safety risk assessors, policy makers and regulators, public health authorities, and consumers by examining production practices and/or interventions strategies to control or reduce postharvest losses through spoilage or pathogenic microflora on resulting carcasses or meat and their products. An important advantage of this smart sensor probes is their amenability in on-line monitoring for quality evaluation of meat as all they are call in-time and on-line sensors. The smart sensors capable of detecting spoilage of meat quickly will be an important aspect in the meat monitoring of supply chain in real time.